

1.0 INTRODUCTION

1.1 Description of the Miamisburg Environmental Management Project

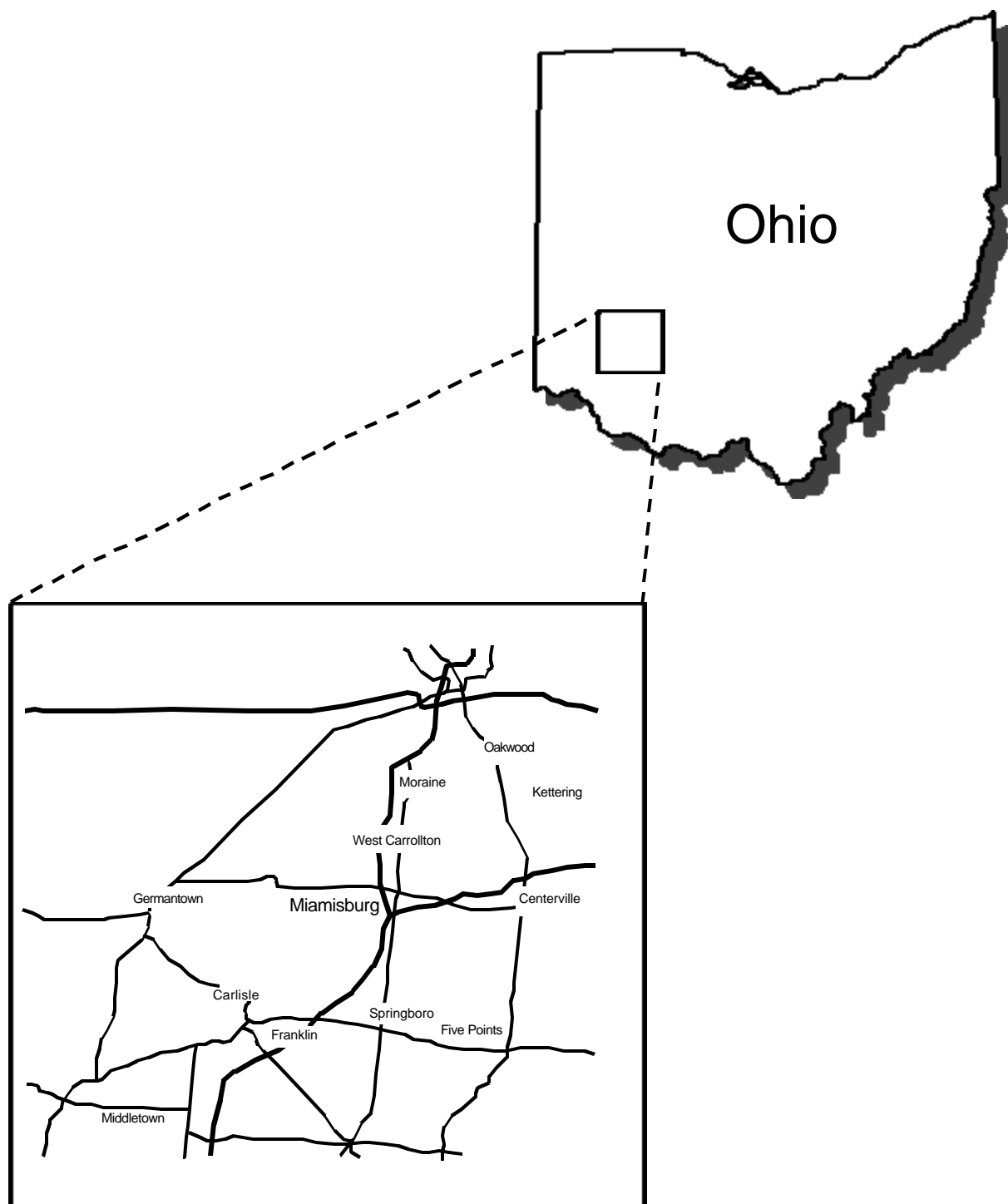
Location

The Miamisburg Environmental Management Project (MEMP) is comprised of 90 buildings on nearly 280 acres of land (at the end of 2000) in Miamisburg, Ohio, approximately 16 km (10 mi) southwest of Dayton (Figure 1-1). The Great Miami River flows southwest through the City of Miamisburg and dominates the geography of the region surrounding MEMP (Figure 1-2). The river valley is highly industrialized. The rest of the region is a mix of farmland, residential areas, small communities and light industry. Many city and township residences, five schools, the Miamisburg downtown area, and six of the city's 17 parks are located within one mile of the site.



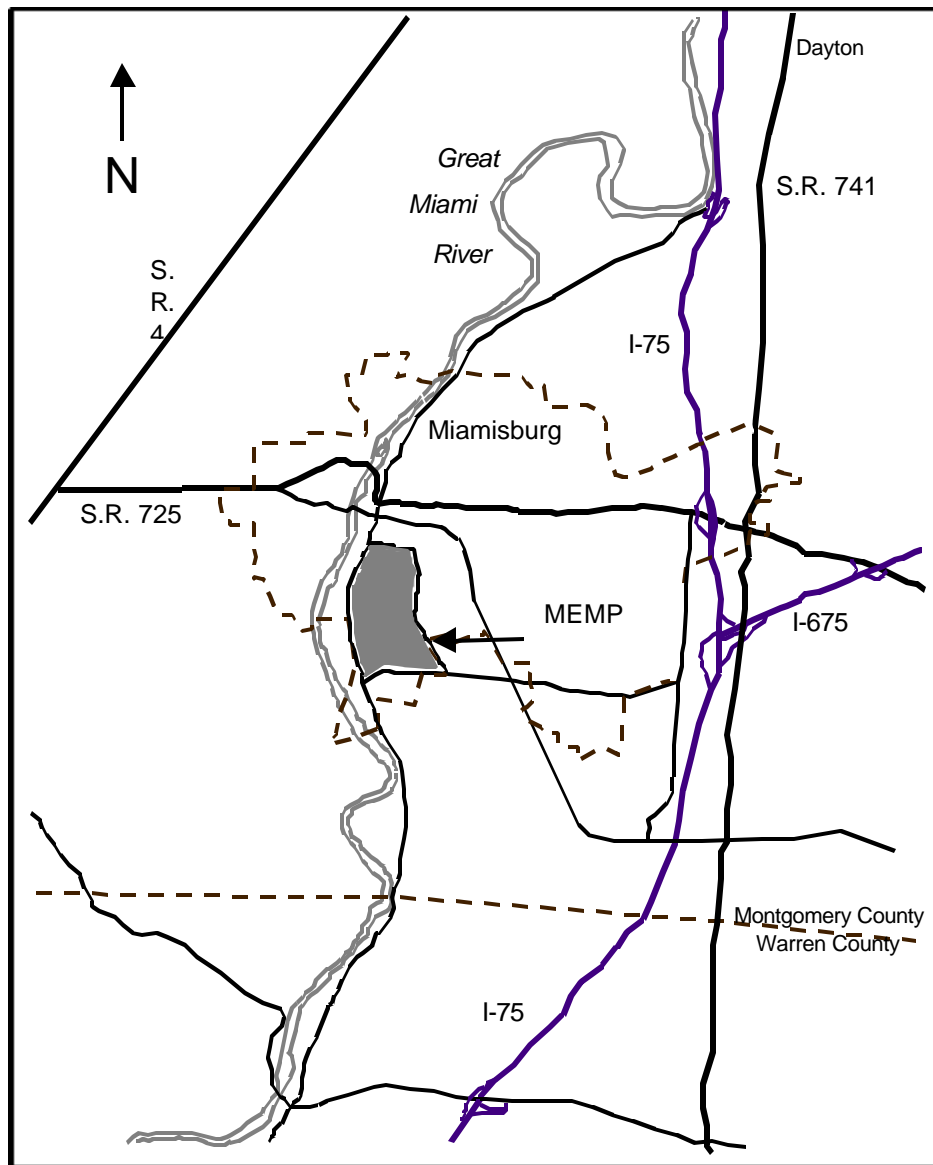
View of MEMP Looking East Across the Great Miami River

Figure 1-1. Locations of Miamisburg and Surrounding Communities



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Figure 1-2. Location of MEMP



Population and Land Use

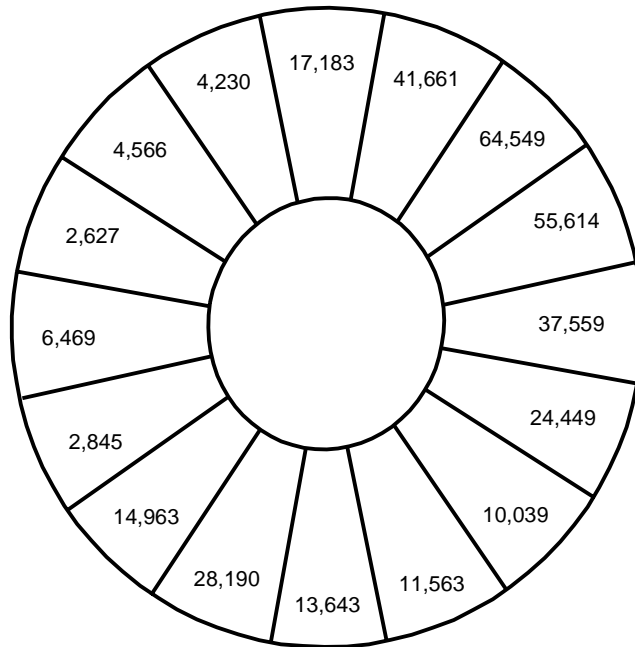
Figure 1-3 shows the population distribution within 50 miles (80 km) of the site. The population information was extracted from 2000 Census data by the Ohio Department of Development. The estimated number of individuals residing within the 50-mile radius is 3,126,615 (Table 1-1). The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the agricultural land is devoted to pasturing livestock.

**Table 1-1. Population Totals from the
2000 Census**

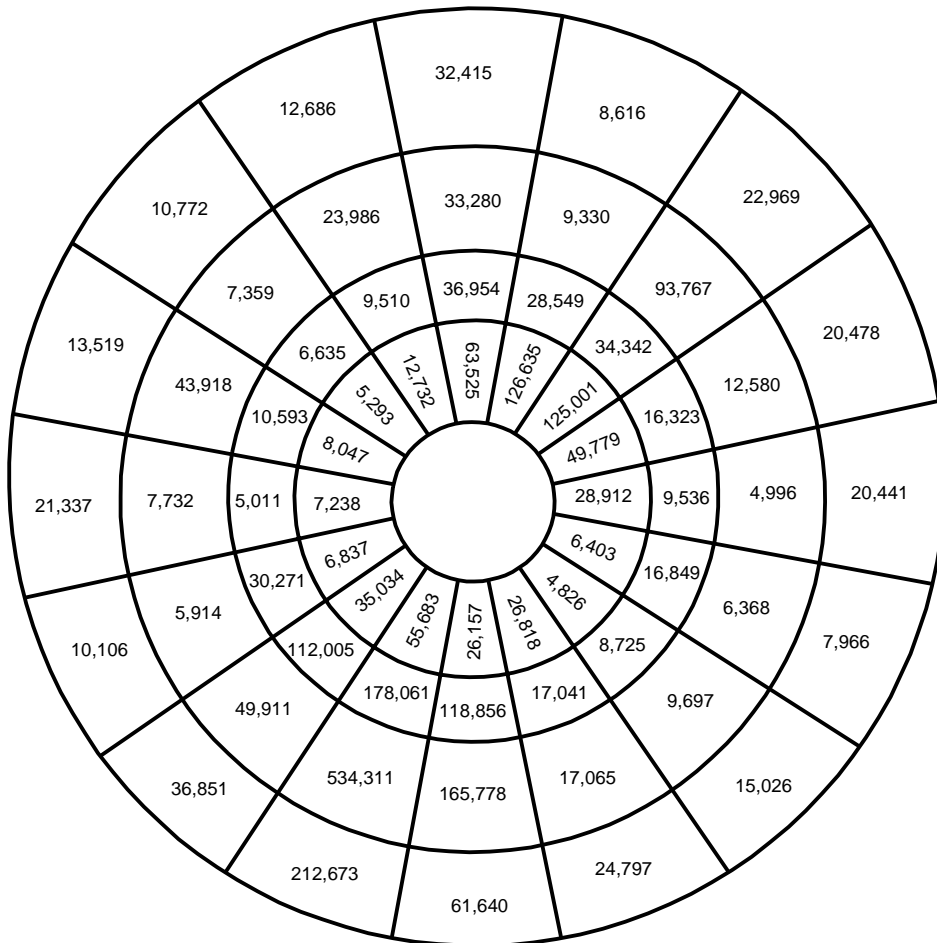
Radius, miles	Total
0-10	340,150
0-20	929,070
0-30	1,568,331
0-40	2,594,323
0-50	3,126,615

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Figure 1-3. Distribution of Population within 50 mi (80 km) of MEMP



0 - 10 Miles



10 - 50 Miles

Geology

The geologic record preserved in the rocks underlying the site indicates that the area has been relatively stable since the beginning of the Paleozoic era more than 500 million years ago. There is no evidence indicating subsurface structural folding, significant stratigraphic thinning, or subsurface faulting. Limestone strata, which are interbedded with shale layers at the site, show no evidence of solution activity. No evidence of solution cavities or cavern development has been observed in any borings or outcrops in the Miamisburg area.

Hydrogeology

The aquifer system of the site consists of two different hydrogeologic environments: groundwater flow through the bedrock beneath the hills and groundwater flow within the unconsolidated glacial deposits and alluvium associated with the Buried Valley Aquifer (BVA) in the Great Miami River valley. The bedrock flow system is dominated by fracture flow and is not considered a productive aquifer. The BVA is dominated by porous flow with interbedded gravel deposits providing the major pathway for water movement. The unconsolidated deposits are Quaternary Age sediments consisting of both glacial and fluvial deposits. The BVA is a highly productive aquifer capable of yielding a significant quantity of water. The BVA is considered a sole source aquifer.

Climate

The climate is moderate. The average annual precipitation rate is 94 cm (37 in) per year. As shown in Figure 1-4, the total precipitation measured at the site in 2000 was 84 cm (33 in). During 2000, winds were predominately out of the south-southwest (Figure 1-5). The annual average wind speed measured at MEMP for 2000 was 5.0 m/s (11.4 mi/hr) (Table 1-2).

Topography

The site topography is shown in Insert 1-1 (see 11 in x 17 in foldout at the end of this Chapter). MEMP site elevations vary from 216 m to 268 m (700 ft to 900 ft) above sea level; most of the site is above 244 m (800 ft). No building in which radioactive material is processed is located below an elevation of 241 m (790 ft). The typical nonflood stage of the Great Miami River is 208 m (682 ft). The highest flood-water levels that can be reasonably postulated for the Great Miami River basin (100-year storm event) would result in flooding to 213 m (700 ft). A narrow area along the southwest border of the site lies within the 100-year floodplain.

Figure 1-4. Monthly Precipitation Measured at MEMP in 2000

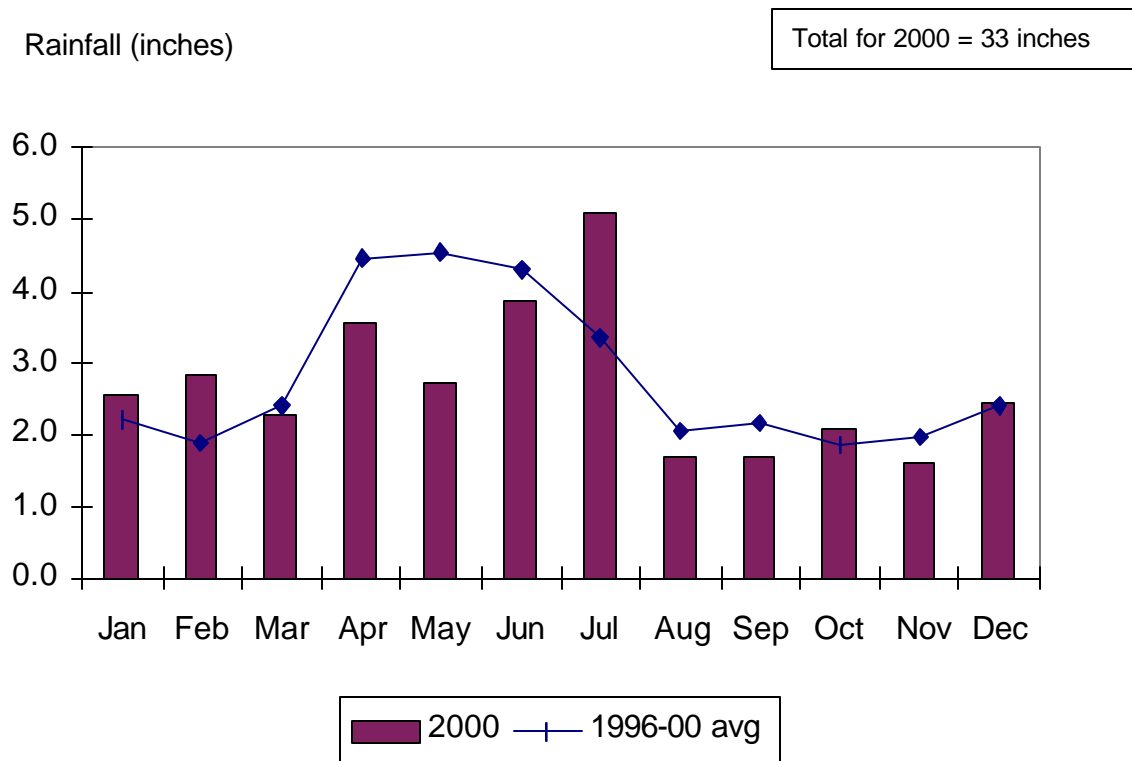
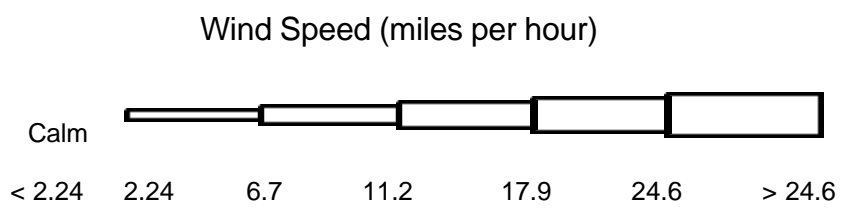


Figure 1-5. 2000 Wind Rose for MEMP



**Table 1-2. Percent Frequency of Wind Direction and Wind Speed from MEMP
50-m Meteorological Tower for 2000**

Direction	Percent of Time Winds From	Average Speed (m/s) ^a
N	5.3	4.1
NNE	5.3	4.1
NE	5.3	4.3
ENE	4.0	4.3
E	3.9	3.8
ESE	3.8	3.8
SE	3.6	3.8
SSE	3.9	4.3
S	10.7	5.5
SSW	13.4	6.0
SW	10.8	5.9
WSW	5.9	5.5
W	6.5	5.8
WNW	6.1	5.1
NW	4.6	4.3
NNW	5.4	4.3
	Average	5.0

^a 1 m/s = 2.24 mi/hr.

Total relative frequency of calms distributed above is 1.5%.

Mission and Operations

In the past MEMP served as an integrated research, development, and production facility in support of DOE weapon and nonweapon programs, especially in the areas of chemical explosives and nuclear technology. The principal mission of MEMP was research, development, and manufacture of non-nuclear explosive components for nuclear weapons that were assembled at another DOE site. Other major operations at MEMP included:

- Manufacture of stable (nonradioactive) isotopes for medical, industrial, and general research.
- Recovery and purification of tritium from scrap materials generated by MEMP and other DOE sites.
- Development and fabrication of radioisotopic thermoelectric generators fueled with plutonium-238 to provide power sources for such projects as lunar experiments, satellites, and spacecraft.
- Surveillance of explosive and radioactive weapons components received from other DOE sites.

Current MEMP objectives include continuing the nuclear energy program mission, environmental restoration, and the transition of the site to the community for reuse as a commercial facility. As a result of recent economic development activities by the Miamisburg Mound Community Improvement Corporation (MMCIC), 30 private businesses are operating at the site.

1.2 Perspective on Radiation

This section puts into perspective the potential consequences of the radionuclide releases described in subsequent sections of this report. Radionuclides emit ionizing radiation. Ionizing radiation is radiation possessing enough energy to remove electrons from the substances through which it passes. Additional background information on radiation can be found in Appendix F, *Principles of Radiation*.

Most consequences to humans from radionuclides are caused by interactions between radiation emitted by the nuclides and human tissue. These interactions involve the transfer of energy from the radiation to the tissue, a process that may damage the tissue. The radiation may come from radionuclides located outside the body (i.e., in or on environmental media and man-made objects) and from radionuclides deposited inside the body via inhalation, ingestion, or absorption through the skin. Exposure to radiation from nuclides located outside the body is called external exposure and will last only as long as the exposed person is near the external source. Exposure to radiation from radionuclides deposited inside the body is called internal exposure and will last as long as the radionuclides remain in the body.

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A number of specialized units are used to characterize exposure to ionizing radiation. Because the damage associated with such exposures is due primarily to the deposition of radiant energy in tissue, these units are described in terms of the amount of energy absorbed by the tissue and the biological consequences of the absorbed energy. Some of the key units are defined below:

- **Absorbed dose** indicates the amount of energy absorbed by a material (e.g., human tissue), divided by the mass of the material. The unit of absorbed dose is the gray (Gy) or the rad (100 rads = 1 Gy).
- **Dose equivalent** indicates the biological effect of an absorbed dose on a particular organ or tissue. It equals the absorbed dose multiplied by factors that relate the absorbed dose to biological effects on that particular organ. The unit of dose equivalent is the sievert (Sv) or the rem (100 rem = 1 Sv).
- **Effective dose equivalent** indicates an individual's cancer risk from an exposure to ionizing radiation. It is calculated from the weighted sum of the dose equivalents from the irradiated organs. It is also expressed in rem or Sieverts.
- **Committed effective dose equivalent** indicates the total dose over the individual's projected remaining lifetime (assumed to be 50 years) that results from an intake during one year. The committed effective dose equivalent (CEDE) expresses the dose of internal radiation received when an individual has ingested, inhaled or absorbed a radionuclide that will remain inside the body. It is also expressed in rem or Sieverts.
- **Collective committed effective dose equivalent** indicates the sum of the committed effective dose equivalents to the individuals in a population. It gives an estimate of the expected health risk to the population from a dose of radiation. It can be used to calculate probable risks that might be too small to predict on the basis of a single individual. It is expressed in person-rem or person-Sieverts.

Sources of Radiation

Every day our bodies absorb ionizing radiation. Most of it comes from natural sources. Consumer products and medical procedures that use radiation are other common sources of ionizing radiation.

Natural Sources. Natural radiation comes from two sources, cosmic and terrestrial. Cosmic radiation results when energetic particles from outer space, traveling at nearly the speed of light, collide with nuclei in our atmosphere, creating showers of radioactive particles that fall to earth. The average annual dose equivalent received from cosmic radiation is 26 mrem (0.26 mSv) for an individual living at sea level. Because cosmic radiation dissipates as it travels through the atmosphere, individuals living at lower altitudes receive less dose from this source than those living at higher altitudes.

Terrestrial radiation results when radionuclides that are a natural part of the earth's rocks and soils emit ionizing radiation. Because the concentrations of these radionuclides vary

geographically, an individual's exposure depends on his location. The average annual dose equivalent from terrestrial radiation for an individual living in the United States (U. S.) is 28 mrem (0.28 mSv).

Internal. Besides absorbing radiation from external radionuclides, we can also absorb radiation internally when we ingest radionuclides along with the water, milk, and food we eat or along with the air we inhale. Once in our bodies, radionuclides follow the same metabolic paths as nonradioactive forms of the same elements. The length of time a particular radionuclide remains in the body depends on whether the body eliminates it quickly or stores it for a long period, and on how long it takes for the radionuclide to decay into a nonradioactive form. The principal source of internal exposure in the U. S. is believed to be radon. Inhalation of radon contributes about 200 mrem (2.0 mSv) to the average annual dose equivalent from internal radiation. Other radionuclides present in the body contribute approximately 39 mrem (0.39 mSv).

Consumer Products. Many familiar consumer products emit ionizing radiation. Some must emit radiation to perform their functions, e. g., smoke detectors and airport x-ray baggage inspection systems. Other products, e.g., TV sets, emit radiation only incidentally to performing their functions. The average annual effective dose equivalent to an individual from consumer products ranges from 6 to 12 mrem (0.06 to 0.12 mSv).

Medical Uses. Radiation is a tool for diagnosing and treating disease. The average annual dose equivalent for an individual in the U. S. from diagnostic radiation is 53 mrem (0.53 mSv). Individuals undergoing therapeutic radiation procedures receive much higher doses, and those receiving diagnostic radioactive testing may also receive much higher doses.

Summary. The contributions to an average individual's annual radiation dose are shown in Figure 1-6. MEMP's maximum contribution for 2000, 0.18 mrem, is too small to be seen in the figure.

Figure 1-6. Average Annual Radiation Dose in the U.S. (NCRP, 1987)

